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10/812,717

03/29/2004

Francimar Schmitt

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EXAMINER

BURKHART, ELIZABETH A

ART UNIT

PAPER NUMBER

1792

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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/812,717	<b>Applicant(s)</b> SCHMITT ET AL.	
	<b>Examiner</b> Elizabeth Burkhart	<b>Art Unit</b> 1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 18 March 2009.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-7 and 9-14 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-7 and 9-14 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                     | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)          | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____  | 6) <input type="checkbox"/> Other: _____                          |

### DETAILED ACTION

1. Claims 1-7 and 9-14 are pending in the application. The amendment filed 3/18/2009 has been entered and carefully considered.

#### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-5, 7, and 9-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shioya, et al. (US 2001/0034140) in view of Allman ('096).

Shioya teaches a method for depositing a low dielectric constant film (see Paragraph [0002]), comprising: delivering a gas mixture comprising: a cycle organosiloxane (see Paragraphs [0076], [0077], and [0080]); and two or more oxidizing gases comprising N<sub>2</sub>O and O<sub>2</sub> (see Paragraph [0081]) to a substrate in a chamber (see again Paragraph [0076]); and applying RF power to the gas mixture at conditions sufficient to deposit a low dielectric constant film on a surface of the substrate (see, e.g., Paragraphs [0076] and [0083]).

Shioya does not teach that the ratio of a flow rate of the N<sub>2</sub>O to a total flow of the two or more oxidizing gases into the chamber is between about 0.1 and about 0.5 or that the deposited film has a carbon content between about 5 and about 30 atomic percent.

Allman teaches a plasma-enhanced chemical vapor deposition (PE-CVD) process, wherein adjusting the relative amounts of  $\text{N}_2\text{O}$  or  $\text{O}_2$  used in an oxidizing gas stream consisting of only  $\text{N}_2\text{O}$  and  $\text{O}_2$  can allow the user to tune the dielectric constant of the oxide film produced (see especially Column 4, lines 32 – 47 of Allman). The ratio of  $\text{N}_2\text{O}$  to oxygen may be 1:1 in the oxidizing gas, thus the ratio of  $\text{N}_2\text{O}$  to the total flow of oxidizing gas would be 0.5 (see Column 5, lines 1-5 of Allman), which falls within the range claimed by Applicants. As it states in the Abstract of Allman, “By controlling the ratio of nitrogen to oxygen in the source gas as used in the CVD method, the ultimate nitrogen, carbon ... concentrations in the film can be controlled and hence the dielectric constant of the film so produced.” Allman further discloses that by reacting the  $\text{N}_2\text{O}$  and  $\text{O}_2$  within selected percentages with the organosilicon precursor, different percentages of carbon can be left behind in the film (Col. 4, lines 32-37), thus the deposited film of Allman would have inherently had a carbon content within the claimed range since the carbon content depends on this selected percentage and the selected percentage disclosed by Allman is within the claimed range for the ratio of  $\text{N}_2\text{O}$  gas to the total oxidizing gas (about 0.1 to about 0.5).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Shioya by using an oxidizing gas composition as described in Allman to have further tuned the dielectric constant of the film being produced via the PE-CVD process disclosed in Shioya.

Regarding Claim 1, Allman teaches that the carbon content is dependent on the selected percentages of  $\text{N}_2\text{O}$  and  $\text{O}_2$  (Col. 4, lines 32-37). As such, it would have been

Art Unit: 1792

obvious to one of ordinary skill to adjust the selected percentages of  $\text{N}_2\text{O}$  and  $\text{O}_2$  through routine experimentation to achieve a desired carbon content, including a content within the claimed range, which in turn would achieve a desired dielectric constant.

Regarding Claim 2, Shioya does not explicitly teach the method wherein the two or more oxidizing gases consist of  $\text{N}_2\text{O}$  and  $\text{O}_2$ . However, as discussed, Shioya does teach, in Paragraph [0081], that “ $\text{N}_2\text{O}$ ,  $\text{O}_2$ ,  $\text{H}_2\text{O}$ , [and]  $\text{CO}_2$  [may be used] as the oxidizing gas ... and at least one of them may be contained in the reaction gas.” Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have selected  $\text{N}_2\text{O}$  and  $\text{O}_2$  as the sole components of the oxidizing gas stream, because Shioya teaches that any combination of these gases may be used as the oxidizing gas in this method.

Regarding Claims 3 – 5, Shioya teaches the method wherein the cyclic organosiloxane is octamethylcyclotetrasiloxane (OMCTS) (see Paragraphs [0056] – [0060]), and the method wherein the gas mixture further comprises an inert gas selected from the group consisting of helium and argon (see Paragraph [0082] and Table 1).

Regarding Claim 7, it is substantially identical to Claim 1, but adds the limitations that the oxidizing gas consists essentially of  $\text{N}_2\text{O}$  and  $\text{O}_2$  (addressed in the rejection of Claim 2, above) and that the  $\text{N}_2\text{O}$  is delivered into the chamber at a flow rate between about  $0.71 \text{ sccm/cm}^2$  and about  $1.42 \text{ sccm/cm}^2$  of substrate surface. Shioya in view of Allman does not explicitly teach the method wherein the  $\text{N}_2\text{O}$  is delivered into the

Art Unit: 1792

chamber at a flow rate between about 0.71 sccm/cm<sup>2</sup> and about 1.42 sccm/cm<sup>2</sup> of substrate surface. However, Shioya does teach, in Paragraph [0123], that an 8-inch silicon wafer is used, which corresponds to a 20 cm diameter wafer, which corresponds to an area of approximately 300 cm<sup>2</sup> of wafer surface area. Furthermore, in Paragraphs [0079] – [0083], and especially in Tables 1 and 2, Shioya teaches that the flow rate of N<sub>2</sub>O in this method may be 200 sccm, which corresponds to 0.67 sccm/cm<sup>2</sup>, which is about 0.71 sccm/cm<sup>2</sup>. Similarly, a *prima facie* case of obviousness exists where the claimed ranges and prior art ranges do not overlap but are close enough that one skilled in the art would have expected them to have the same properties. *Titanium Metals Corp. of America v. Banner*, 778 F.2d 775, 227 USPQ 773 (Fed. Cir. 1985). See MPEP 2144.05 I. Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Shioya in view of Allman by delivering the N<sub>2</sub>O into the chamber at a flow rate of about 0.71 sccm/cm<sup>2</sup>, because Shioya teaches that such conditions for deposition are known.

Regarding Claims 9 and 10, Shioya in view of Allman does not explicitly teach the method wherein the gas mixture further comprises a linear hydrocarbon, and wherein the linear hydrocarbon is ethylene. However, Shioya does teach that linear hydrocarbons such as ethylene may be used to help reduce the dielectric constant in films produced via plasma deposition from other types of organosilicon precursors with oxidizing gases (see Paragraphs [0092] – [0100], and especially Paragraphs [0099] and [0100]). Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Shioya in view

Art Unit: 1792

of Allman by utilizing a gas mixture further comprising ethylene as taught in Shioya, because Shioya teaches that the inclusion of such precursors helps reduce the dielectric constant of the film produced using similar organosilicon precursors.

Regarding Claims 11 and 12, Shioya teaches that the cyclic organosiloxane is OMCTS (see Paragraphs [0056], [0058], and [0060]).

Regarding Claim 13, Shioya teaches that the gas mixture further comprises an inert gas selected from the group consisting of helium or argon (see Paragraph [0082] and Table 1).

Thus, claims 1-5, 7, and 9-13 would have been obvious within the meaning of 35 USC 103 over the combined teachings of Shioya and Allman.

3. Claims 6 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shioya in view of Allman as applied above, and further in view of Ross ('777).

Shioya and Allman do not teach the method further comprising post-treating the low dielectric constant film with an electron beam.

Ross teaches just such a limitation (see Summary of the Invention of Ross, Column 3, lines 55 – 60, "The invention also provides a process for forming a dielectric layer on a substrate which comprises chemical vapor depositing a dielectric layer on a substrate and then exposing the chemical vapor deposited dielectric layer to electron beam radiation for a sufficient time, temperature, electron beam energy and electron beam dose to reduce the dielectric constant of the layer.") As discussed above, Shioya teaches a method for producing low dielectric constant films.

Art Unit: 1792

Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Shioya in view of Allman by using the e-beam treatment taught by Ross to have further reduced the dielectric constant of the low dielectric constant film.

Thus, claims 6 and 14 would have been obvious within the meaning of 35 USC 103 over the combined teachings of Shioya, Allman, and Ross.

### ***Double Patenting***

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the “right to exclude” granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

4. Claims 1 – 5 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over Claims 1, 9, and 13 of U.S. Patent No. 6,797,643 in view of Allman, for substantially the same reasons given for Claims 1 – 5 above.



Art Unit: 1792

5. Claim 6 is rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over Claim 1 of U.S. Patent No. 6,797,643 in view of Allman, and further in view of Ross, for substantially the same reasons given above regarding Claim 6.

6. Claims 7 and 9 – 13 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over Claims 1, 9, 13, and 14 of U.S. Patent No. 6,797,643 in view of Allman and further in view of Li. As discussed above, Claim 7 is essentially identical to Claim 1, but adds the limitation that the  $N_2O$  be delivered into the chamber at a flow rate of between about 0.71 and about 1.42 sccm/cm<sup>2</sup> of substrate surface. However, Li discloses just such a limitation, as described above. Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have used the  $N_2O$  flow rates disclosed in Li in the film deposition process disclosed in the '643 patent, because Li teaches that such conditions are suitable for deposition (see Paragraph [0061] of Li, and Paragraph 17 in this Action for further analysis). Claims 9 and 10 of the present application read directly on Claim 14 of the '643 patent, in view of Allman and Li. Claims 11 and 12 of the present application read directly on Claims 9 and 13 of the '643 patent, in view of Allman and Li. Claim 13 of the present application reads directly on Claim 1 of the '643 patent, in view of Allman and Li, wherein the gas mixture further comprises an inert gas selected from the group consisting of helium, argon, and mixtures thereof, as disclosed in the Specification of the '643 patent in Column 9, lines 14 – 22.

Art Unit: 1792

7. Claim 14 is rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claim 1 of U.S. Patent No. 6,797,643 in view of Allman and Li, and further in view of Ross, for substantially the same reasons given above regarding Claim 6.

8. Claims 7 and 9 – 13 are also rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over Claims 1, 9, 13, and 14 of U.S. Patent No. 6,797,643 in view of Allman and further in view of Shioya. As discussed above, Claim 7 is essentially identical to Claim 1, but adds the limitation that the N<sub>2</sub>O be delivered into the chamber at a flow rate of between about 0.71 and about 1.42 sccm/cm<sup>2</sup> of substrate surface. However, Shioya discloses just such a limitation, as described above. Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have used the N<sub>2</sub>O flow rates disclosed in Shioya in the film deposition process disclosed in the '643 patent, because Shioya teaches that such conditions are suitable for deposition (see Paragraph 21 of this Action for further analysis). Claims 9 and 10 of the present application read directly on Claim 14 of the '643 patent, in view of Allman and Shioya. Claims 11 and 12 of the present application read directly on Claims 9 and 13 of the '643 patent, in view of Allman and Shioya. Claim 13 of the present application reads directly on Claim 1 of the '643 patent, in view of Allman and Shioya, wherein the gas mixture further comprises an inert gas selected from the group consisting of helium, argon, and mixtures thereof, as disclosed in the Specification of the '643 patent in Column 9, lines 14 – 22.

Art Unit: 1792

9. Claim 14 is rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over Claim 1 of U.S. Patent No. 6,797,643 in view of Allman and Shioya, and further in view of Ross, for substantially the same reasons given above regarding Claim 6.

### ***Response to Arguments***

10. Applicant's arguments filed 3/18/2009 have been fully considered but they are not persuasive. Applicant argues that Allman does not discuss the carbon content of the resultant film and as such provides no insight as to how the carbon content of a deposited film may be controlled. The examiner disagrees. Allman discloses in the Abstract that "by **controlling the ratio of nitrogen to oxygen in the source gas** as used in the CVD method, the ultimate nitrogen, **carbon**, and fluorine **concentrations in the film can be controlled**" (emphasis added). Allman also discloses in Col. 4, lines 32-37 that "By using N<sub>2</sub>O alone or as one of the oxidizing source gases, TEOS is not fully oxidized, **leaving carbon behind in the film being produced. By reacting N<sub>2</sub>O and O<sub>2</sub> within selected percentages** with TEOS, **different percentages of carbon can be left behind in the film**" (emphasis added). Therefore, Allman clearly discusses carbon content of the resultant film and provides insight as to how to control the carbon content (i.e. controlling ratio of nitrogen to oxygen).

Applicant argues that adjusting the ratio of N<sub>2</sub>O and O<sub>2</sub> does not necessarily result in a change of the ratio of carbon atoms in the resultant film, as the resultant film may contain more types of atoms (such as carbon, silicon, nitrogen, oxygen, and hydrogen) instead of only nitrogen, oxygen, and carbon atoms. Applicant further argues

Art Unit: 1792

that simply adjusting the ratio of  $N_2O$  and  $O_2$  supplied does not automatically mean the carbon ratio formed in the resultant film will be changed or controlled. The examiner disagrees. As discussed above, Allman discloses that the carbon content (concentration) in the resultant film is directly correlated to the ratio of nitrogen to oxygen which controls the extent of oxidation of the precursor. The concentration of carbon in the resultant film is necessarily controlled by adjusting the ratio of  $N_2O$  and  $O_2$  despite their being other types of atoms present since Allman discloses that the carbon concentration is controlled in the resultant film by adjusting this ratio wherein the resultant film also contains silicon, oxygen, nitrogen, carbon, and fluorine. Since Allman discloses a direct correlation between the ratio of  $N_2O$  and  $O_2$  and the carbon content left behind in the resultant film, adjusting this ratio would necessarily change or control the carbon content (concentration) left behind in the resultant film, especially since the only source of carbon in the process of Shioya is the precursor [0078]-[0085].

Applicant argues that there is no reasonable expectation of success that the resultant film would have similar film properties when the main precursor (TEOS) has been switched to a different precursor since switching may result in complex and different process mechanisms that have even more types of atoms involved during reaction. The examiner disagrees. One of ordinary skill would have had a reasonable expectation of success in controlling the carbon content in the film of Shioya using an organosiloxane as the precursor by controlling the ratio of  $N_2O$  and  $O_2$  as suggested by Allman since Shioya discloses that the organosiloxanes and precursors such as TEOS have similar properties with respect to the carbon content in the deposited film. Since

Art Unit: 1792

Si-O bonds are formed originally in these compounds, it's difficult to form a large number of Si-C bonds [0055]-[0056]. Also, the same types of atoms are involved during reaction for both precursors.

Applicant argues that neither Allman nor Shioya teach or specify what range of carbon content in the resultant film is desired. The examiner agrees. However, it would have been obvious to one of ordinary skill in light of the teachings of Allman to vary the selected ratio of nitrogen to oxygen through routine experimentation in order to deposit a film having a desired carbon content since the carbon content is dependent on the selected ratio. Also, Shioya discloses that a small number of Si-C bonds are desired to prevent the generation of leakage currents [0055].

Applicant argues that there is no teaching or suggestion from Allman to modify its precursor TEOS to the precursor taught by Shioya. Please note that the test of obviousness is not an express suggestion of the claimed invention in any or all references, but rather what the references taken collectively would suggest to those of ordinary skill in the art presumed to be familiar with them (*In re Rosselet*, 146 USPQ 183). As addressed above Shioya teaches that organosiloxanes have similar properties as TEOS with respect to Si-C bonding in the deposited film and that these compounds are suitable as an alternative to TEOS for a plasma deposition process.

### **Conclusion**

11. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Elizabeth Burkhart whose telephone number is (571)272-6647. The examiner can normally be reached on M-Th 7-5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on 571-272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a

Application/Control Number: 10/812,717

Page 14

Art Unit: 1792

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/Elizabeth Burkhardt/  
Examiner, Art Unit 1792

/Timothy H Meeks/  
Supervisory Patent Examiner, Art Unit 1792